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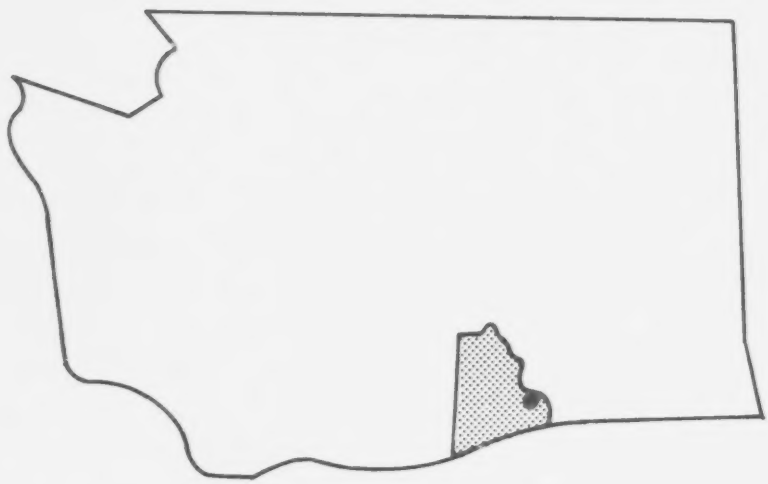
FLOOD INSURANCE STUDY

CITY OF KENNEWICK, WASHINGTON
BENTON COUNTY



REVISED:MARCH 5, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 530011

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original FIS. These revisions are presented in Section 9.0.

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PUBLISHED SEPARATELY

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF KENNEWICK, BENTON COUNTY, WASHINGTON

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Kennewick, Benton County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Kennewick to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and floodplain development.

1.2 Coordination

Selection of areas to be studied by detailed methods took place during a pre-contract meeting in mid-April, 1976. Participants in attendance, which included local representatives of the City of Kennewick, the consultant, the State of Washington Department of Ecology, and the Federal Emergency Management Agency (FEMA), determined study areas based on previous floods and their impact on the community.

On October 21, 1977, an intermediate coordination meeting was held at the Kennewick City Hall to discuss the preliminary results of the study and its effects upon the city. In attendance were representatives of the City of Kennewick, FEMA, and the study contractor. No changes were made as a result of the meeting.

The U.S. Army Corps of Engineers (COE), the U.S. Geological Survey (USGS), and the U.S. Bureau of Reclamation were contacted for the purpose of coordinating information on streamflows and past flood data. The State of Washington Department of Ecology was contacted to determine their concerns regarding this Flood Insurance Study.

To obtain documentation on past flooding, private photo collections were examined. This coordination began at the April 1976 meeting in Kennewick and continued through correspondence.

The results of this study were reviewed at a final community coordination meeting held on July 26, 1978. Attending the meeting were representatives of FEMA, the study contractor, and the city. No problems were raised at the meeting.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Howard, Needles, Tammen & Bergendoff for FEMA under Contract No. H-4009. This work, which was completed in March 1978, covered all significant flooding sources affecting the City of Kennewick.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Kennewick, Benton County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by overflow of the Zintel Canyon were studied in detail. The Columbia River and two smaller drainage flows were studied by approximate methods.

Areas selected for study by approximate methods are prone to flooding, but damage to property is considered to be less severe than in those areas which were selected to be studied by detailed methods.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

2.2 Community Description

The City of Kennewick is located in southeastern Benton County in south-central Washington. Based on a 1975 census (Reference 1), the population of Kennewick is 18,253, which is an increase of 3,041 over the 1970 census (Reference 2). Kennewick is in the Tri-City group with Pasco, located immediately to the north across the Columbia River, and Richland, located approximately 9 miles to the northwest. The economy of the area is tied to agriculture and the Energy Resources Development Administration Hanford Works.

The three streams being studied in Kennewick are all intermittent drainage flows which begin in the hills to the south of the city and flow northward toward the Columbia River. Zintel Canyon, the largest stream, originates in the Horse Heaven Hills and flows through an area that contains extensive residential development. One of the unnamed streams flows through the Westgate area and the other flows south from East 4th Avenue between South Beech and South

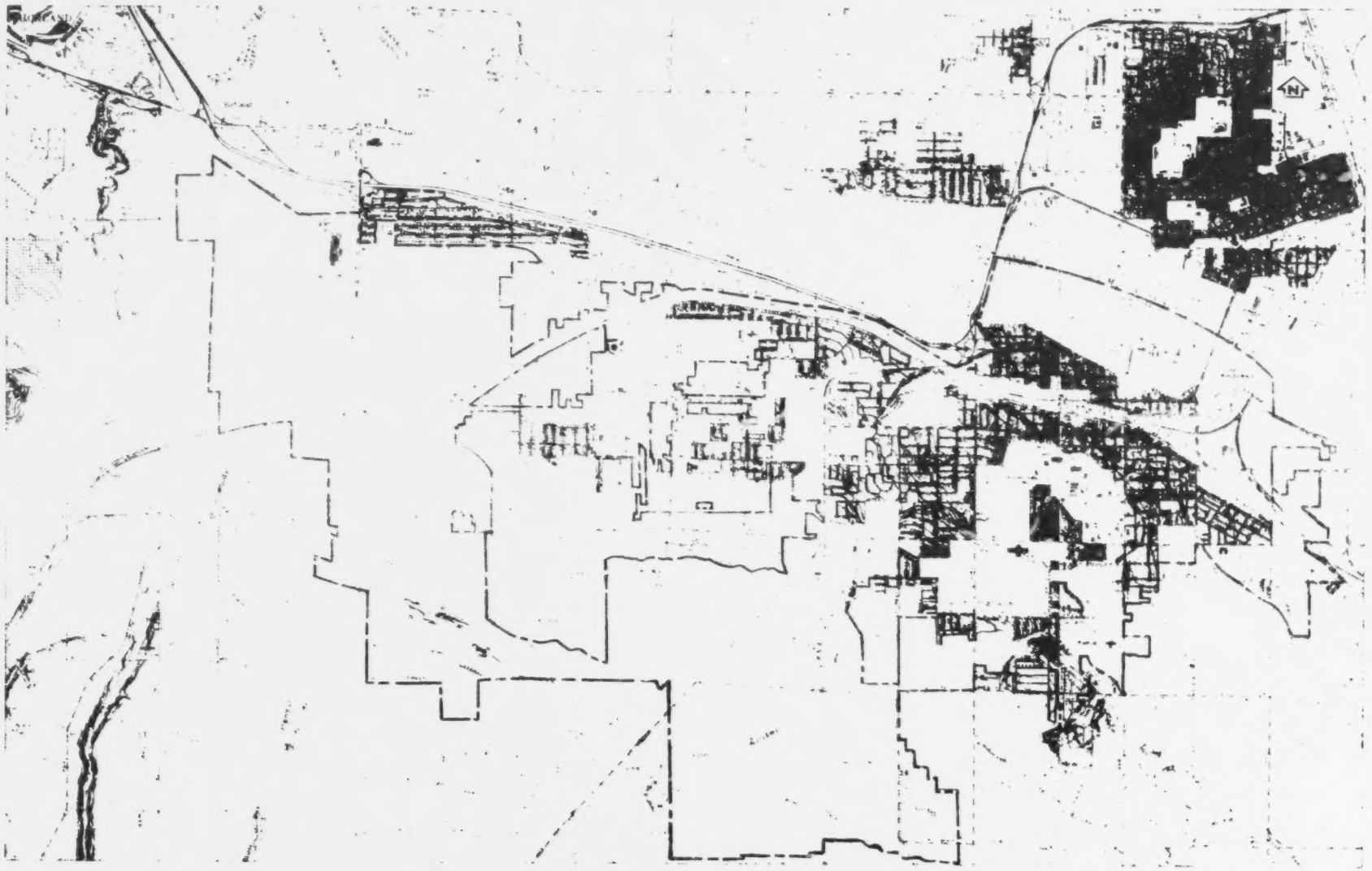

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KENNEWICK, WA

(BENTON CO.)

APPROXIMATE SCALE

5 000 0 5 000 10 000 15 000 FEET

VICINITY MAP

Gum Streets. Both of these streams are in residential areas. The topography is one of hills rising to the south above the Columbia River floodplain. Vegetation within the study area is predominately grasses and deciduous trees and shrubs. The residential areas have scattered evergreen trees. The climate is typical of eastern Washington with hot, dry summers and cold winters. Precipitation reaches its peak in the winter months with an annual average of approximately 7.5 inches (Reference 3).

2.3 Principal Flood Problems

Zintel Canyon and the two unnamed streams covered in this study flood periodically as a result of rapid snowmelt and heavy rains. The most severe floods have resulted when the above conditions are compounded by frozen, unpenetrable soil. Beginning in the Horse Heaven Hills, runoff flows into a restricted floodplain within Zintel Canyon but spreads quickly over the floodplain as it widens into an alluvial fan at the mouth of the canyon. From the mouth of Zintel Canyon at West 7th Avenue to the Columbia River, there is no defined channel for the Zintel Canyon floods.

Newspaper reports document major floods in Zintel Canyon in 1949, 1952, 1956, 1959 and 1964. The 1949 flood was reported as doing $75,000 worth of damage. Damages totaling $50,000 were reported in 1956 (Reference 4).

2.4 Flood Protection Measures

There are currently no flood protection measures in operation or planned for the streams studied in Kennewick for the next five years (through 1983). Kennewick's northern corporate limits are on Lake Wallula, a regulated reservoir on the Columbia River behind McNary Dam.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents

the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

There are no stream gaging stations located on Zintel Canyon. Values of 10-, 50-, and 100-year peak discharges were obtained from a log-Pearson Type III distribution using the computer program FREQFLO (Reference 5) and compared with the results obtained from the regional relationships. The values of the 10-, 50-, and 100-year peak discharges obtained from regional relationships were adjusted using average factors derived from the gage stations in the area having similar characteristics (References 6 through 13). The 500-year peak discharge was obtained by extrapolating a frequency curve plotted for calculated peak discharges.

Peak discharge-drainage area relationships for Zintel Canyon are shown in Table 1.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 100-Year
Zintel Canyon At 7th and Vancouver Intersection	24.3	2,400
Zintel Canyon Flow East At 7th and Olympia Intersection	24.5	1,830

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Cross section data for Zintel Canyon were obtained by field measurements and supplemented by a USGS topographic map (Reference 14) and a 2-foot contour map furnished by the city (Reference 15).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (FBFM) (Exhibit 2).

Roughness coefficients (Manning's "n") were estimated by field inspection of the stream and floodplain and verified by standard text (Reference 16). The roughness values for the main channel and the overbanks was 0.070.

Elevation data and structural geometry for all bridges were obtained from field surveys in order to compute the significant backwater effects of these structures.

Water-surface elevations were developed using a HEC-2 step-backwater computer model (References 17 and 18). Profiles were determined for the 10-, 50-, 100-, and 500-year floods. Results of these analyses were compared with historic floods, and flood stages for the streams were determined. Starting water-surface elevations for the backwater analysis were determined by slope-area calculations.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Some portions of the Zintel Canyon flow are susceptible to relatively uniform shallow flooding, characterized by depths less than 3 feet. Other areas are flooded with deeper water.

Elevations for the deep ponding area near Garfield Street and 10th Avenue are given in Table 2.

Table 2. Summary of Elevations

Flooding Source and Location	Elevation (Feet) 100-Year
Zintel Canyon	
At 7th and Vancouver Intersection	443.6
Zintel Canyon Flow East	
At 7th and Olympia Intersection	409.0
Flow Southeast	
At 5th and Ione Intersection	395.7
Flow Southeast	
At 10th and Garfield Intersection	392.3

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOODPLAIN MANAGEMENT APPLICATION

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound floodplain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound floodplain management measures.

4.1 Floodplain Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of floodplain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scale of 1:24,000, with a contour interval of 10 feet (Reference 14).

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries along the two unnamed streams studied were determined by approximate methods. Approximate flood boundaries were determined using local accounts and observations of past floods, field inspection of the area and experienced professional judgment using existing mapping.

Approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (FHBM) (Reference 19).

Flood boundaries for the 100- and 500-year floods are shown on the FBFM (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on floodplains, such as artificial fill, reduces flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodway for this study was computed on the basis of equal conveyance reduction from each side of the floodplain.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the FBFM (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Zintel Canyon								
A	1.13	418	779	2.5	432.4	432.4	432.4	0.0
B	1.25	170	291	6.6	441.9	441.9	441.9	0.0
C	1.54	170	456	4.2	468.6	468.6	469.6	1.0
D	1.61	120	490	3.9	471.7	471.7	472.2	0.5
E	1.88	80	216	8.9	488.8	488.8	488.8	0.0
F	2.12	110/55[2]	479	4.0	504.0	504.0	504.9	0.9
G	2.34	100	414	4.6	511.8	511.8	512.5	0.7
H	2.80	100	892	2.2	551.1	551.1	551.1	0.0

[1]Miles Above Mouth
[2]Total Width/Width Inside Corporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KENNEWICK, WA
(BENTON CO.)

FLOODWAY DATA

ZINTEL CANYON

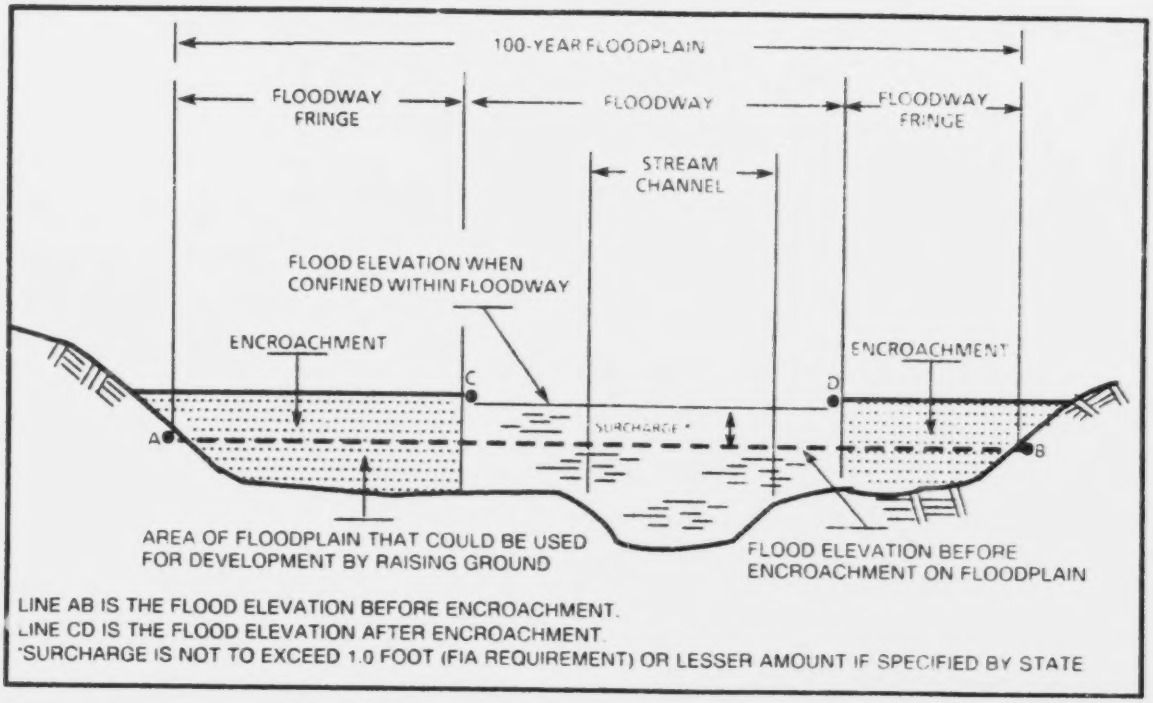
100-YEAR FLOODPLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE *
AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting the City of Kennewick.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet

Three reaches meeting the above criteria were required for the flooding sources of the City of Kennewick. These included three on Zintel Canyon. The location of these reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The FHF is the FEMA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Kennewick was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not permitted for such areas, no base flood elevations or depths are shown within this zone.

Zone AO

Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.

Zone AH

Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

Zone A3, A4, A15

Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.

Zone B

Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year floodplain that are protected from the 100-year flood by dike, levee, or other water-control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C

Areas of minimal flooding.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 4.

5.4 Flood Insurance Rate Map (FIRM) Description

The FIRM for the City of Kennewick is, for insurance purposes, the principal result of the Flood Insurance Study.

This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

Under an initial identification date of June 7, 1974, FEMA published an FHBM for the City of Kennewick. The map was subsequently revised with the latest revision date being August 23, 1977 (Reference 19). Comparing the flood boundaries determined in that study with the findings of this report, minor differences were found. The differences are in the area east of Quincy Street where this study shows the flooding to be of the same width but north of the former study. The difference is attributed to the type and extent of analysis and to the accuracy of the mapping materials available to the two studies.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100 - YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10 - YEAR)	2% (50 - YEAR)	0.2% (500 - YEAR)			
Zintel Canyon							
Reach 1	0008	-1.6	-0.4	+1.0	015	A3	Varies - See Map
Reach 2	0008	-2.0	-0.7	+1.5	020	A4	Varies - See Map
Reach 3	0008	-7.4	-0.5	+1.0	075	A15	Varies - See Map
Deep Ponding Area Near Garfield Street and West 10th Avenue	0008	-1.7	-0.5	+1.0	015	A3	391
Sheet Flow	0004,0008	N/A	N/A	N/A	N/A	AO	Depth 2
	0008	N/A	N/A	N/A	N/A	AH	Varies - See Map

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KENNEWICK, WA
(BENTON CO.)

FLOOD INSURANCE ZONE DATA

ZINTEL CANYON

Flood boundaries delineated in the FHBM (Reference 19) were used for those areas in northeastern Kennewick contiguous to the Columbia River, and along the extreme eastern perimeters of the city.

In early January 1976, the COE visually inspected the Quad Apartments in Kennewick at the request of an engineering company for the purpose of securing flood hazard information (Reference 20). From the visual observation, it was the opinion of the COE that the elevation of the first floor of the building was approximately 1.5 feet below the 100-year flood level. In general, this study shows the depth of water to be approximately 1 foot deep at these apartments.

A study was begun by the Walla Walla District of the COE to design a project in Zintel Canyon which would protect Kennewick from the 100-year flood. Because of a lack of local sponsorship, the project has been dropped (Reference 21).

In response to a request for a 100-year floodplain study, the COE in 1976 studied the area of Zintel Canyon from west 7th Avenue to West 10th Avenue (Reference 22). This Flood Insurance Study is in agreement with the COE study.

Flood Insurance Studies are currently underway for the unincorporated areas of Benton County. In the Kennewick area, the study included the area of Zintel Canyon from West 10th Avenue to just south of West 27th Avenue. This Flood Insurance Study is in complete agreement with the County study.

This Flood Insurance Study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of FEMA, Regional Director, Federal Regional Center, Bothell, Washington 98011.

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9.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at City Hall, 210 West 6th Avenue, Kennewick, Washington 99336.

9.1 First Revision

This study was revised on March 5, 1990, to incorporate the effects of revised hydrologic and hydraulic analyses for a reach of Zintel Canyon extending from the intersection of 7th and Vancouver Streets in the City of Kennewick to the Kennewick Sump area in Benton County, Washington. The revised analyses were prepared by the COE, Walla Walla District.

The hydrologic analyses were carried out to establish the peak discharge-frequency relationships for a flood having a 100-year recurrence interval along Zintel Canyon, downstream to the Kennewick Sump area. There are no stream gaging stations located in the study area. Therefore, all flood flow frequency relationships were derived analytically using available precipitation, soil, and snow data, and available data from previous floods experienced in the area, to develop all frequency curves. Regional relationships were also examined to compare the derived curves with similar watersheds in the area having gaged data available. The entire study area is subject to two different types of floods: (1) general rainstorm floods, and (2) thunderstorm floods. General rainstorm floods may occur with or without snowmelt and generally produce a relatively low discharge, large runoff volumes, and have a longer duration of flooding (approximately one to three days). Thunderstorm floods may have extremely high peak discharges, relatively small runoff volumes, and shorter durations of flooding, generally less than six hours. All general rainstorm floods analyzed were developed using the HEC-1 hydrologic model and all thunderstorm floods were developed using the Streamflow Synthesis and Reservoir Regulations (SSARR) model. Because the topsoils in the area are generally easily erodible, sedimentation effects were also considered in all analyses. The general rain and thunderstorm flood frequency curves were combined analytically to give a composite frequency curve, which was used for the hydraulic analyses. See Table 1 for a summary of peak discharge and drainage area relationships for several locations in the study area.

Analyses of the hydraulic characteristics of the study area were caried out to provide estimates of the elevations of floods of the 100-year recurrence interval along Zintel Canyon to the Kennewick Sump.

Cross section data were obtained by field measurement and supplemented by USGS topographic mapping, COE, Walla Walla District, mapping, City of Kennewick mapping, and Columbia Irrigation District (CID) mapping.

Water-surface elevations were computed for areas from the Kennewick Sump upstream to the 7th and Vancouver intersection in Kennewick using a series of HEC-2 steady state step-backwater computer models. Water-surface elevations were determined for the 100-year Composite Flood along each study reach. Starting water-surface elevations for the backwater model for Zintel Canyon upstream of Tacoma Street in Kennewick were determined by an energy analysis of the Kennewick flow split area located east of Tacoma Street, and was taken to be the energy required to sustain the 100-year flood flow both east and north from the flow split area. Flow north was assumed to be parallel to Rainier and Quincy Streets and flow east was assumed to be parallel to 7th and 6th Avenues. Critical depth was used as the starting water-surface elevation for the backwater models extending from the CID canal crossing, located immediately southeast of the 10th Avenue and Garfield Street intersection, upstream to Tacoma Street in Kennewick. The Kennewick Sump pool elevation occurring at the time of the peak inflow rate to the sump was used for the starting water-surface elevation for the backwater model extending from the Kennewick Sump upstream to the CID canal crossing. The pool elevation and time of occurrence was determined from the HEC-1 routing model of the Kennewick Sump and contributing drainage basins.

The revised floodplain boundaries were delineated on a workmap submitted by the COE entitled "Kennewick-Benton County, Washington, Zintel Canyon-Kennewick Sump Flood Insurance Study Workmap," dated March 25, 1988. The 100-year flood boundaries were delineated using the flood elevations determined at each cross section; between cross sections the boundaries were interpolated using the best available mapping and drawn onto base maps derived from the USGS topographic maps at a scale of 1:24,000 and a contour interval of 10 feet. The 1:24,000 scale was expanded to provide a base map scale of 1"=400'. The best available mapping for areas west of Olympia Street in Kennewick was the COE mapping at a scale of 1:600 and a contour interval of 2 feet. The best available mapping for the area between Olympia and Garfield Streets was City of Kennewick mapping at a scale of 1:1,200 and a contour interval of 2 feet. East of Garfield Street the best available mapping was CID mapping at a scale of 1:2,400 and a contour interval of 5 feet. All available mapping had spot elevations to further enhance their contour information. The USGS mapping used as the base mapping, having a contour interval of 10 feet, occasionally was in disagreement with the mapping having small contour intervals. In these instances, the flood boundaries were drawn in conflict with the USGS contour lines and based on the information found on the maps having the smaller contour interval.

The results of the revised analyses are as follows:

- The 100-year peak discharge of Zintel Canyon at West 7th Avenue was increased from 1,920 cfs to 2,400 cfs.

- The 100-year water-surface elevation at the intersection of 10th Avenue and Garfield Street was increased from 391 feet to 392.3 feet as shown on FIRM Panel 530011 0008 and in the Summary of Elevations Table.

- The 100-year floodplain in the vicinity of Ione and Hartford Streets was extended approximately 500 feet farther to the north than presently shown on effective FIRM Panel 0008.

- The Special Flood Hazard Area (SFHA) extending north from the intersection of South Gum Street and East 13th Avenue to the intersection of Beech Street and East 4th Avenue was revised from Zone A to Zone B. This SFHA was determined to be an area of localized ponding with a drainage area of less than 1 square mile. This modification is shown on FIRM Panels 0008 and 0009.

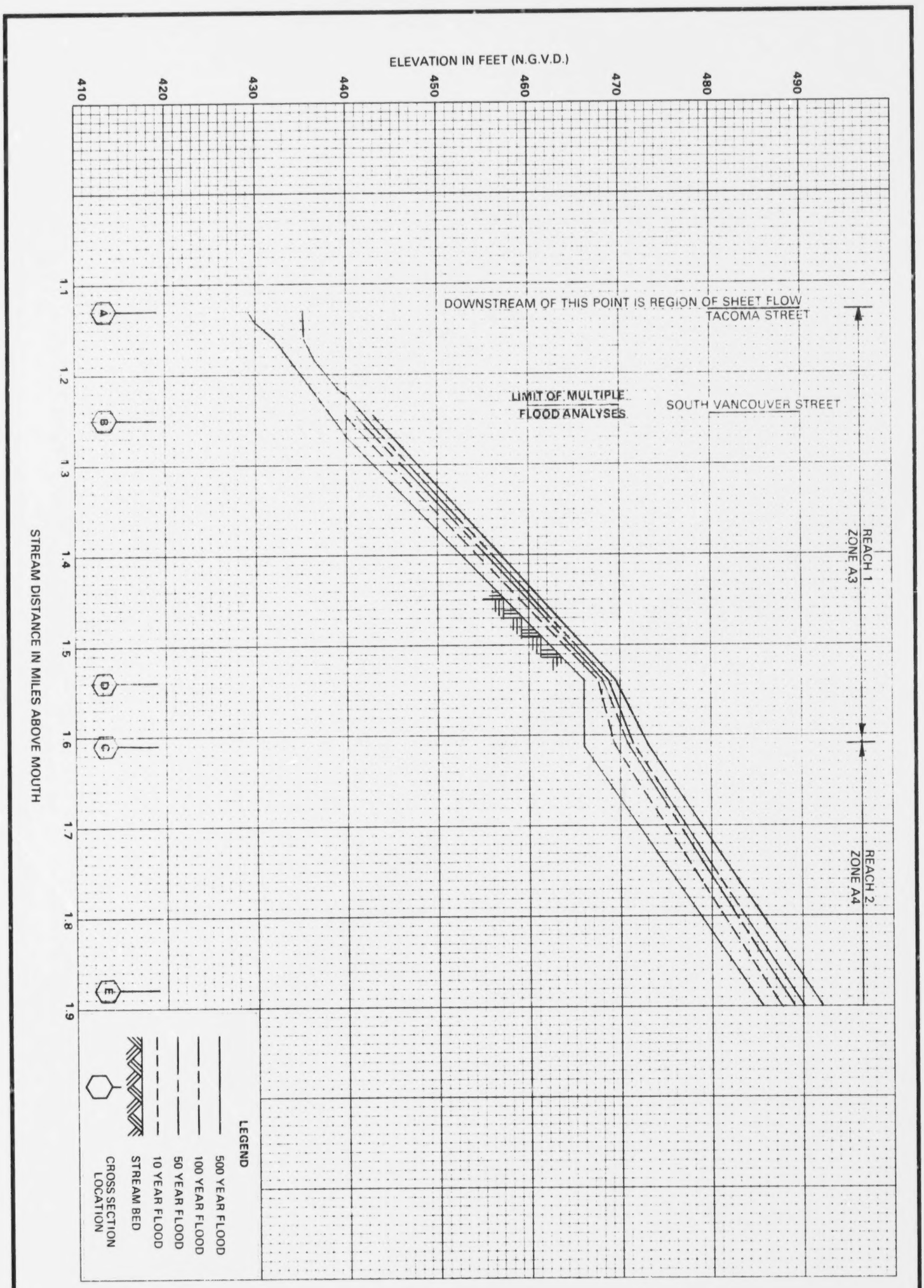
- The overland flowpath extending east from Zintel Canyon at Tacoma Street to the vicinity of South Ione Street was changed from Zone AO to Zone AH and base flood elevations have been added, as shown on FIRM Panel 0008.

- The area along the overland flowpath from Ione Street extending southeast to West 10th Avenue was redesignated from Zone A3 to Zone AH, as shown on FIRM Panel 0008.

- At the intersection of West 5th Avenue and South Olympia Street, the floodplain was extended approximately 800 feet farther to the south than shown on the effective FIRM Panel 0008.

- Due to corporate limit changes that have occurred since the effective FIRM, dated May 5, 1981, was published, SFHAs were added to FIRM Panel 0008 along Zintel Canyon that were previously shown on the Benton County FIRM Panel 530237 0609 B, dated July 19, 1982.

FIRM Panels 0008 and 0009 have been revised to reflect the aforementioned changes. The Summary of Discharges Table and the Summary of Elevations Table have been revised to reflect the effects of the revised hydrologic and hydraulic analyses. All corporate limit changes, as of the date of this revision, have been included on the revised FIRM panels for the City of Kennewick.



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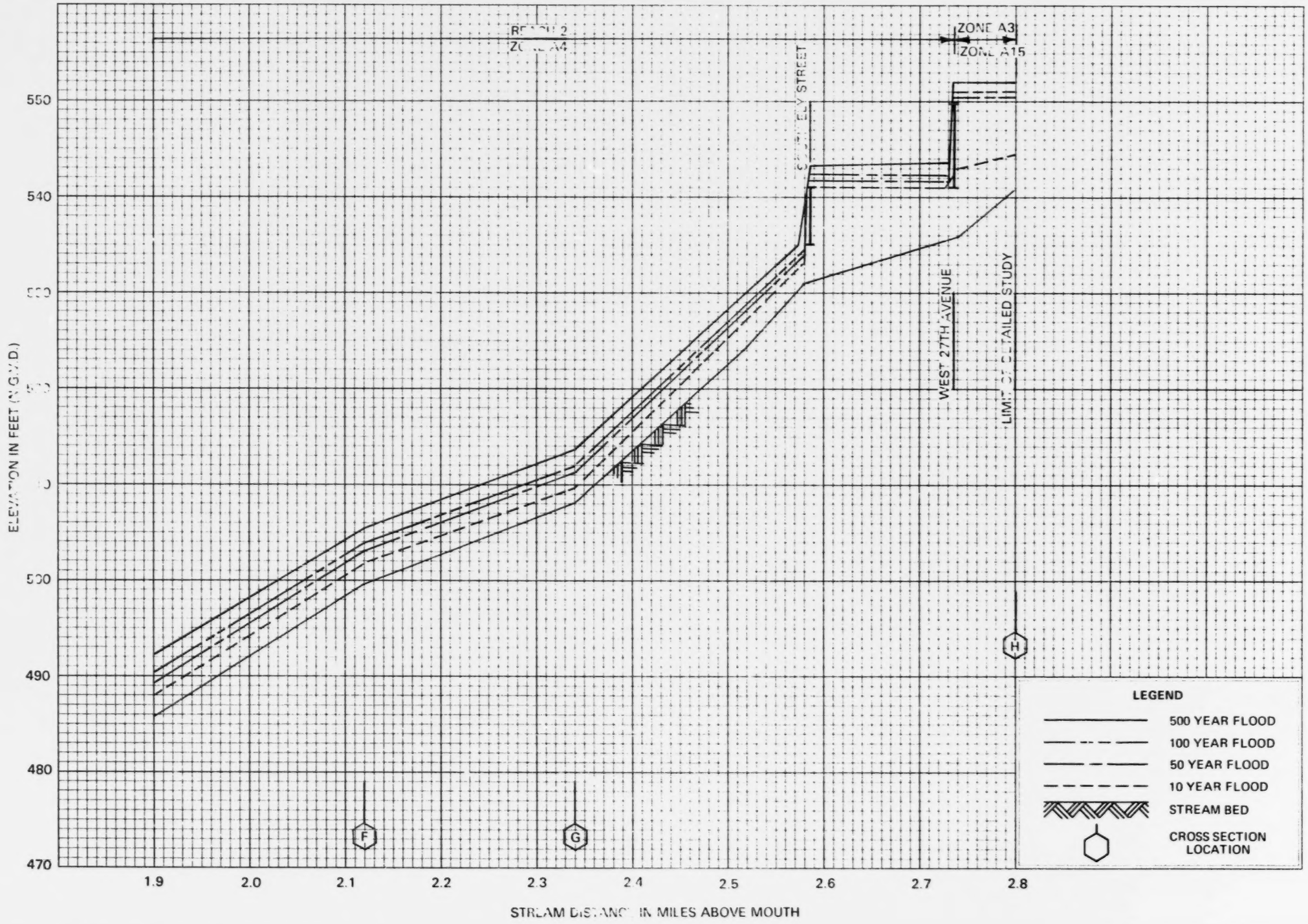

FLOOD PROFILES

ZINTEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

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